CLAIMS

What is claimed is:

1. A method of estimating an impairment correlation matrix in a spread spectrum wireless receiver comprising:

estimating a first impairment correlation matrix based on despread symbols received over multiple paths of a multi-path channel;

estimating a second impairment correlation matrix based on the despread symbols; and

deriving a final impairment correlation matrix based on the first and second impairment correlation matrices.

2. The method of claim 1 wherein deriving the final impairment correlation matrix based on the first and second impairment correlation matrices comprises selecting one of the first and second impairment correlation matrices as the final impairment correlation matrix.

3. The method of claim 2 wherein selecting one of the first and second impairment correlation matrices as the final impairment correlation matrix comprises selecting the first impairment correlation matrix as the final impairment correlation matrix when a color of the first impairment correlation matrix meets or exceeds a predetermined color criteria.

4. The method of claim 1 wherein deriving the final impairment correlation matrix from the first and second impairment correlation matrices comprises combining the first and second impairment correlation matrices.

5. The method of claim 4 wherein combining the first and second impairment correlation matrices comprises:

subtracting a filtered version of the first impairment correlation matrix from the second impairment correlation matrix to generate a residual correlation matrix; and

adding the residual correlation matrix to the first impairment correlation matrix to derive the final impairment correlation matrix.

6. The method of claim 1 wherein deriving the final impairment correlation matrix from the first and second impairment correlation matrices comprises:

subtracting a filtered version of the first impairment correlation matrix from the second impairment correlation matrix to generate a residual correlation matrix;

filtering the residual correlation matrix;

augmenting the first impairment correlation based on the filtered residual correlation matrix to generate an augmented correlation matrix; and

deriving the final impairment correlation matrix based on the augmented correlation matrix.

7. The method of claim 1 wherein estimating the second impairment correlation matrix based on the despread symbols comprises estimating the second impairment correlation matrix based on the first impairment correlation matrix.

8. The method of claim 7 wherein deriving the final impairment correlation matrix based on the first and second impairment correlation matrices comprises:

computing a whitening matrix based on the first impairment correlation matrix;

applying an inverse of the whitening matrix to the second impairment correlation matrix to generate a final residual correlation matrix; and

combining the first impairment correlation matrix with the final residual correlation matrix to derive the final impairment correlation matrix.

9. The method of claim 7 wherein deriving the final impairment correlation matrix based on the first and second impairment correlation matrices comprises:

computing a whitening matrix inverse based on the first impairment correlation matrix;

applying the whitening matrix inverse to the second impairment correlation matrix to generate a final residual correlation matrix;

augmenting the first impairment correlation matrix based on the final residual correlation matrix to generate an augmented correlation matrix; and

deriving the final impairment correlation matrix based on the augmented correlation matrix.

10. The method of claim 7 wherein estimating the second impairment correlation matrix based on the first impairment correlation matrix comprises:

generating a whitening matrix based on the first impairment correlation matrix;

computing a whitened error vector based on the whitening matrix; and

estimating the second impairment correlation matrix based on the whitened error vector.

11. The method of claim 10 further comprising generating a despread error vector based on the despread values, wherein computing a whitened error vector based on the whitening matrix comprises multiplying the despread error vector by the whitening matrix.

12. The method of claim 1 further comprising generating a despread error vector based on the despread values, wherein estimating the first and second impairment correlation matrices based on the despread symbols comprises estimating the first and second impairment correlation matrices based on the despread error vector.

13. The method of claim 1 wherein estimating the first impairment correlation matrix based on the despread symbols comprises determining channel estimates based on the despread symbols and estimating a parametric impairment correlation matrix based on the channel estimates.

14. The method of claim 1 wherein estimating the second impairment correlation matrix based on the despread symbols comprises estimating a non-parametric impairment correlation matrix based on the despread symbols.

15. The method of claim 1 further comprising generating weighting factors based on the final impairment correlation matrix and combining traffic despread symbols using the weighting factors to suppress interference.

16. The method of claim 1 further comprising estimating a signal-to-interference ratio based on the final impairment correlation matrix.

17. The method of claim 1 wherein estimating the first and second impairment correlation matrices comprises estimating the first and second correlation matrices for multiple time slots of a received signal, and wherein deriving the final impairment correlation matrix based on the first and second impairment correlation matrices comprises selecting the first impairment correlation matrix as the final impairment

correlation matrix for the time slots when a color of the first impairment correlation matrix meets or exceeds a predetermined color criteria.

18. The method of claim 1 wherein the spread spectrum wireless receiver comprises a RAKE receiver.

19. The method of claim 1 wherein the wireless spread spectrum receiver is disposed in at least one of a mobile station and a base station.

20. The method of claim 1 wherein estimating the first and second impairment correlation matrices comprises determining channel estimates based on the despread symbols and estimating at least one of the first impairment correlation matrix and the second impairment correlation matrix based on the channel estimates.

21. An impairment correlation estimator in a spread spectrum wireless receiver comprising:

a first correlation estimator for estimating a first impairment correlation matrix based on despread symbols received over multiple paths of a multi-path channel;

a second correlation estimator for estimating a second impairment correlation matrix based on the despread symbols; and

a correlation processor for deriving a final impairment correlation matrix based on the first and second impairment correlation matrices.

22. The impairment correlation estimator of claim 21 wherein the correlation processor comprises a selector for selecting one of the first and second impairment correlation matrices as the final impairment correlation matrix.

23. The impairment correlation estimator of claim 21 wherein the correlation processor comprises a combiner for combining the first and second impairment correlation matrices to derive the final impairment correlation matrix.

24. The impairment correlation estimator of claim 23 wherein the combiner comprises:

a smoothing filter for smoothing the first impairment correlation matrix;

a subtractor for subtracting the smoothed first impairment correlation matrix from the second impairment correlation matrix to generate a residual correlation matrix; and

a summer for combining the residual correlation matrix with the first impairment correlation matrix to derive the final impairment correlation matrix.

25. The impairment correlation estimator of claim 21 wherein the correlation processor comprises:

a smoothing filter for smoothing the first impairment correlation matrix;

a subtractor for subtracting the smoothed first impairment correlation matrix from the second impairment correlation matrix to generate a residual correlation matrix;

a feedback loop for filtering the residual correlation matrix and augmenting the first impairment correlation matrix based on the filtered residual correlation matrix to generate an augmented correlation matrix; and

means for deriving a final impairment correlation matrix based on the augmented correlation matrix.

26. The impairment correlation estimator of claim 21 wherein the second correlation estimator further estimates the second impairment correlation matrix based on the first impairment correlation matrix.

27. The impairment correlation estimator of claim 26 wherein the correlation processor comprises:

a converter to apply an inverse of a whitening matrix to the second impairment correlation matrix to generate a final residual correlation matrix; and

a combiner to combine the first impairment correlation matrix with the final residual correlation matrix to derive the final impairment correlation matrix.

28. The impairment correlation estimator of claim 26 wherein the correlation processor comprises a converter to apply an inverse of a whitening matrix to the second impairment correlation matrix to generate a final residual correlation matrix, wherein the first correlation estimator applies the final residual correlation matrix to the first impairment correlation matrix to generate an augmented correlation matrix and wherein the correlation processor derives the final impairment correlation matrix from the augmented correlation matrix.

29. The impairment correlation estimator of claim 26 wherein the second correlation estimator comprises:

a whitening matrix unit for generating a whitening matrix based on the first impairment correlation matrix;

a multiplier for generating a whitened error vector based on the whitening matrix, the despread symbols, and the channel estimates; and

an impairment estimator for estimating the second impairment correlation matrix based on the whitened error vector.

30. The impairment correlation estimator of claim 29 further comprising a signal remover for determining a despread error vector based on the despread symbols and channel estimates, wherein the multiplier multiplies the despread error vector by the whitening matrix to generate the whitened error vector.

31. The impairment correlation estimator of claim 21 further comprising a signal remover for generating a despread error vector based on the despread symbols and the channel estimates, wherein the first and second estimators estimate the first and second impairment correlation matrices based on the despread error vector.

32. The impairment correlation estimator of claim 21 wherein the first correlation estimator is a parametric estimator and wherein the first impairment correlation matrix is a parametric impairment correlation matrix.

33. The impairment correlation estimator of claim 32 wherein the parametric estimator comprises:

a correlation computer for measuring impairment correlations based on the despread values;

a structure element computer for determining structured elements of an impairment model based on channel estimates;

a parameter estimator for determining model fitting parameters based on the structured elements and the measured impairment correlations; and

an impairment correlation calculator for calculating the first impairment correlation matrix based on the model fitting parameters and the structured elements

34. The impairment correlation estimator of claim 33 wherein the impairment correlation calculator calculates the parametric impairment correlation matrix $\mathbf{R}_A$ according to:

$$\mathbf{R}_A = \alpha\mathbf{R}_1 + \beta\mathbf{R}_2,$$

where α and β are model fitting parameters and $\mathbf{R}_1$ and $\mathbf{R}_2$ are structured elements corresponding to one or more impairment models.

35. The impairment correlation estimator of claim 21 wherein the second correlation estimator is a non-parametric estimator and wherein the second impairment correlation matrix is a non-parametric impairment correlation matrix.

36. The impairment correlation estimator of claim 35 wherein the non-parametric estimator comprises:

a correlation computer for measuring impairment correlations based on the despread values; and

a filter for filtering the impairment correlation measurements over multiple time slots of a received signal.

37. The impairment correlation estimator of claim 36 further comprising a signal remover for determining a despread error vector based on the despread symbols and on channel estimates, wherein the correlation computer multiplies despread error values in the despread error vector by conjugates of other despread error values in the despread error vector to generate the measured impairment correlations.

38. The impairment correlation estimator of claim 21 further comprising a control unit for evaluating a color of the first impairment correlation matrix.

39. The impairment correlation estimator of claim 38 wherein the control unit disables at least the second correlation estimator when the color of the first impairment correlation matrix meets or exceeds a predetermined color criteria.

40. The impairment correlation estimator of claim 21 wherein the wireless receiver is disposed in at least one of a mobile station and a base station.

41. A method of suppressing interference in a wireless spread spectrum receiver comprising:

despreading symbols received over multiple paths of a multi-path channel;

estimating first and second impairment correlation matrices based on the despread symbols;

deriving a final impairment correlation matrix based on the first and second impairment correlation matrices; and

combining the despread symbols using weighting factors determined from the final impairment correlation matrix to suppress the interference.

42. The method of claim 41 wherein deriving the final impairment correlation matrix based on the first and second impairment correlation matrices comprises selecting one of the first and second impairment correlation matrices as the final impairment correlation matrix.

43. The method of claim 41 wherein deriving the final impairment correlation matrix based the first and second impairment correlation matrices comprises combining the first and second impairment correlation matrices.

44. The method of claim 41 wherein estimating the second impairment correlation matrix based on the despread symbols comprises estimating the second impairment correlation matrix based on the first impairment correlation matrix.

45. The method of claim 44 wherein estimating the second impairment correlation matrix based on the first impairment correlation matrix comprises:

generating a whitening matrix based on the first impairment correlation matrix;

generating a whitened error vector based on the whitening matrix; and

estimating the second impairment correlation matrix based on the whitened error vector.

46. The method of claim 41 wherein estimating the first impairment correlation matrix based on the despread symbols comprises determining channel estimates based on the despread symbols and estimating a parametric impairment correlation matrix based on the channel estimates.

47. The method of claim 41 wherein estimating the second impairment correlation matrix based on the despread symbols comprises estimating a non-parametric impairment correlation matrix based on the despread symbols.

48. The method of claim 41 wherein the wireless spread spectrum receiver is disposed in at least one of a mobile station and a base station.

49. A method of estimating a signal-to-interference ratio in a wireless spread spectrum receiver comprising:

despreading symbols received over multiple paths of a multi-path channel;

estimating first and second impairment correlation matrices based on the despread symbols;

deriving a final impairment correlation matrix based on the first and second impairment correlation matrices; and

estimating the signal-to-interference ratio based on the final impairment correlation matrix.

50. The method of claim 49 wherein deriving the final impairment correlation matrix based on the first and second impairment correlation matrices comprises selecting one of the first and second impairment correlation matrices as the final impairment correlation matrix.

51. The method of claim 49 wherein deriving the final impairment correlation matrix based the first and second impairment correlation matrices comprises combining the first and second impairment correlation matrices.

52. The method of claim 49 wherein estimating the second impairment correlation matrix based on the despread symbols comprises estimating the second impairment correlation matrix based on the first impairment correlation matrix.

53. The method of claim 52 wherein estimating the second impairment correlation matrix based on the first impairment correlation matrix comprises:

generating a whitening matrix based on the first impairment correlation matrix;

generating a whitened error vector based on the whitening matrix; and

estimating the second impairment correlation matrix based on the whitened error vector.

54. The method of claim 49 wherein estimating the first impairment correlation matrix based on the despread symbols comprises determining channel estimates based on the despread symbols and estimating a parametric impairment correlation matrix based on the channel estimates.

55. The method of claim 49 wherein estimating the second impairment correlation matrix based on the despread symbols comprises estimating a non-parametric impairment correlation matrix based on the despread symbols.

56. The method of claim 49 wherein the wireless spread spectrum receiver is disposed in at least one of a mobile station and a base station.

57. A computer readable media stored in a wireless communication device for storing a set of instructions to estimate an impairment correlation matrix, the set of instructions comprising

instructions to estimate a first impairment correlation matrix based on despread symbols received over multiple paths of a multi-path channel;

instructions to estimate a second impairment correlation matrix based on the despread symbols; and

instructions to derive a final impairment correlation matrix based on the first and second impairment correlation matrices.

58. The computer readable media of claim 57 wherein the instructions to derive the final impairment correlation matrix based on the first and second impairment correlation matrices comprises instructions to select one of the first and second impairment correlation matrices as the final impairment correlation matrix.

59. The computer readable media of claim 57 wherein the instructions to derive the final impairment correlation matrix from the first and second impairment correlation matrices comprises instructions to combine the first and second impairment correlation matrices.

60. The computer readable media of claim 57 wherein the wireless communication device is disposed in at least one of a mobile station and a base station.